TEST REPORT

Eclipse PA220 Power Amplifier, Eclipse R220 Receiver and the Eclipse T220 Exciter

tested for compliance with the

Code of Federal Regulations (CFR) 47

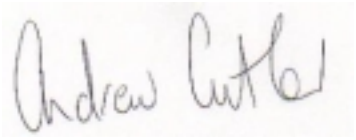
Part 90 –Private Land Mobile Services

Part 15 – Radio Frequency Devices

for

RF Technology Pty Ltd

This Test Report is issued with the authority of:



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Prepared By:

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1. CLIENT INFORMATION

Company Name	RF Technology Pty Ltd
Address	Unit 10, 8 Leighton Place Hornsby
State	NSW 2007
Country	Australia
Contact	Mr Ron Tiley

2. DESCRIPTION OF TEST SAMPLE

Brand Name	Eclipse
System Model	200 Series Equipment
Product	Base Station
FCC ID	KRE200A/AN
Model, Product	PA220 Power Amplifier.
Serial number	7463.
FCC ID	KREPA220A/AN
Model, Product	R220 Receiver.
Serial number	1973
FCC ID	KRER200A/AN
Model, Product	T220 Exciter.
Serial number	7462
FCC ID	KERT200A/AN
Manufacturer	RF Technology Pty Ltd
Country of Origin	Australia

3. SUMMARY OF TEST RESULTS

Testing was carried out in accordance with the test methods defined in 47 CFR Part 2. Listed below are the relevant Part 2 test methods and the limits defined in Part 90 and Part 15.

CLAUSE	TEST PERFORMED	RESULT
2.1041	Measurement procedures	Noted
2.1046	RF power output	Noted
90.205	Power and antenna height limits	Complies
2.1047(a)	Voice modulated communication equipment	Complies
2.1047(b)	Equipment which employs modulation limiting	Complies
90.211(a)	Modulation characteristics	Complies
2.1049	Occupied bandwidth	Noted
90.207	Types of emissions	Complies
90.209	Bandwidth limitations	Complies
90.210	Emission masks	Complies
2.1051	Spurious emissions at the transmitter antenna terminals	Complies
2.1053	Field strength of transmitter spurious radiation	Complies
15.109	Receiver radiated emissions	Complies
15.111	Antenna power conduction limits for receivers	Complies
2.1055	Frequency stability	Noted
90.213	Frequency stability	Complies
90.214	Transient frequency behavior	Not applicable
2.1057	Frequency spectrum to be investigated	Noted
15.33	Frequency range of unintentional radiators	Noted

4. TEST SAMPLE DESCRIPTION

The sample tested is a VHF base station which consisted of separate receiver, exciter and power amplifier modules which, were all contained in a common 19" rack.

Rated Transmitter Output Power

110 Watts (50.4 dBm)

Test frequency

221.0000 MHz

Band of operation

215.0 – 240.0 MHz

FCC Band of operation

220.0 – 222.0 MHz

Emission Types and Necessary Bandwidths

11k0F3E

Authorised bandwidth

11.0 kHz

Channel spacing

12.5 kHz

CTCSS frequency

107.2 Hz

Power Supply

13.8 Vdc from an external DC power supply (eg lead acid battery).

5. TEST CONDITIONS

Standard Temperature and Humidity

Temperature: +25°C ± 4° maintained.
Relative Humidity: 60% ± 10% observed.

Extreme Temperature

High Temperature: + 50°C maintained.
Low Temperature: - 30 °C maintained.

Tests carried out in 10° intervals over this range.

Extreme Test Voltages

High Voltage: 15.9 Vdc
Low Voltage: 11.7 Vdc

6. ATTESTATION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification with the following conditions:

The test sample was selected by the client.

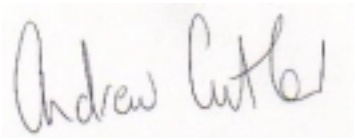
The report relates only to the sample tested.

This report does not contain corrections or erasures.

Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

In addition this equipment has been tested in accordance with the requirements contained in the appropriate Commission regulations. To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Commission standards and demonstrate that the equipment complies with the appropriate standards.

I further certify that the necessary measurements were made by EMC Technologies NZ Ltd, 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand.



Andrew Cutler
General Manager
EMC Technologies NZ Ltd

7. TRANSMITTER TEST RESULTS

RF power ouput

Measurements were carried out at the RF output terminals of the transmitter using a 30 dB power attenuator and a spectrum analyser using a resolution bandwidth wider than the occupied bandwidth of the transmitter operating in peak hold.

A resolution bandwidth of 30 kHz has been used.

Measurements made with and with out CTCSS applied with an input voltage of 13.8 Vdc.

RF power output (dBm)			
Frequency	**CTCSS**	**Rated**	**Measured**
221.0000	Yes	50.4	51.1
221.0000	No	50.4	51.1

Limits:
Part 90 contains no transmitter base power limits.

Section 90.205(e) refers to Section 90.729 which defines the maximum allowable station ERP which is dependent upon the station's antenna HAAT and required service area.

Result: Complies

Measurement Uncertainty: *±0.5 dB*

Modulation Characteristics

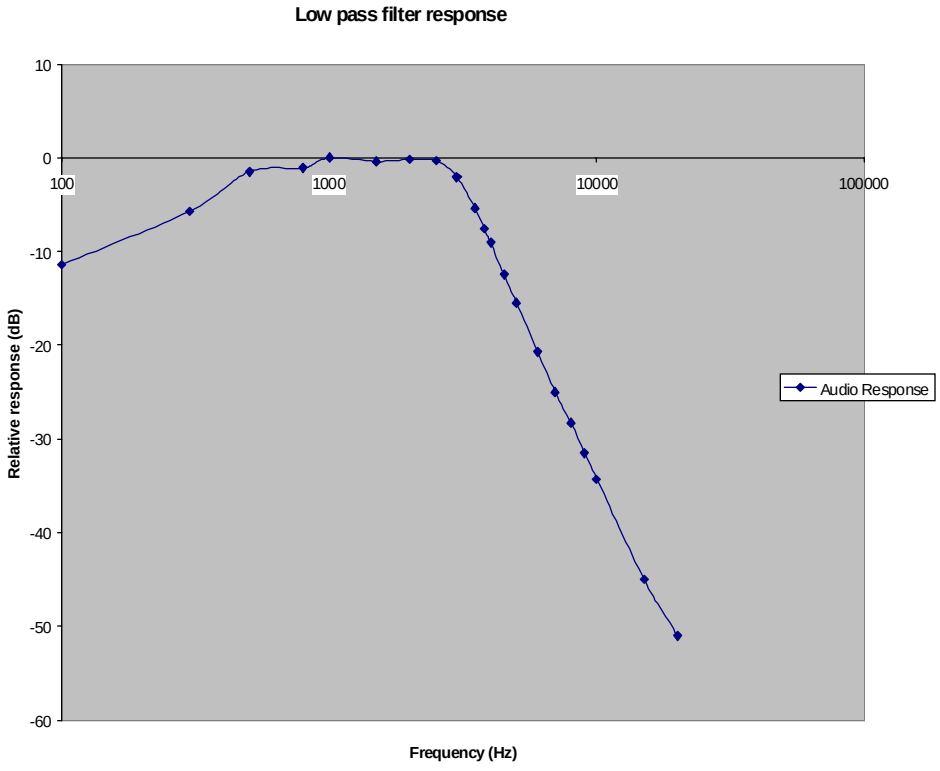
The following graphs are attached:

(a) Frequency response of the audio frequency low pass filter between 100 Hz and 20 kHz.

This measurement was carried out using an audio signal generator and an audio modulation analyser.

At 1 kHz an audio signal was applied which was used as a 0 dB response reference. CTCSS was not applied.

The frequency of the input signal was then varied and the output response noted. This measurement was carried out from 100 Hz to 20000 Hz as required by Part 2 with further measurements carried out in order to show the full range of this filter.



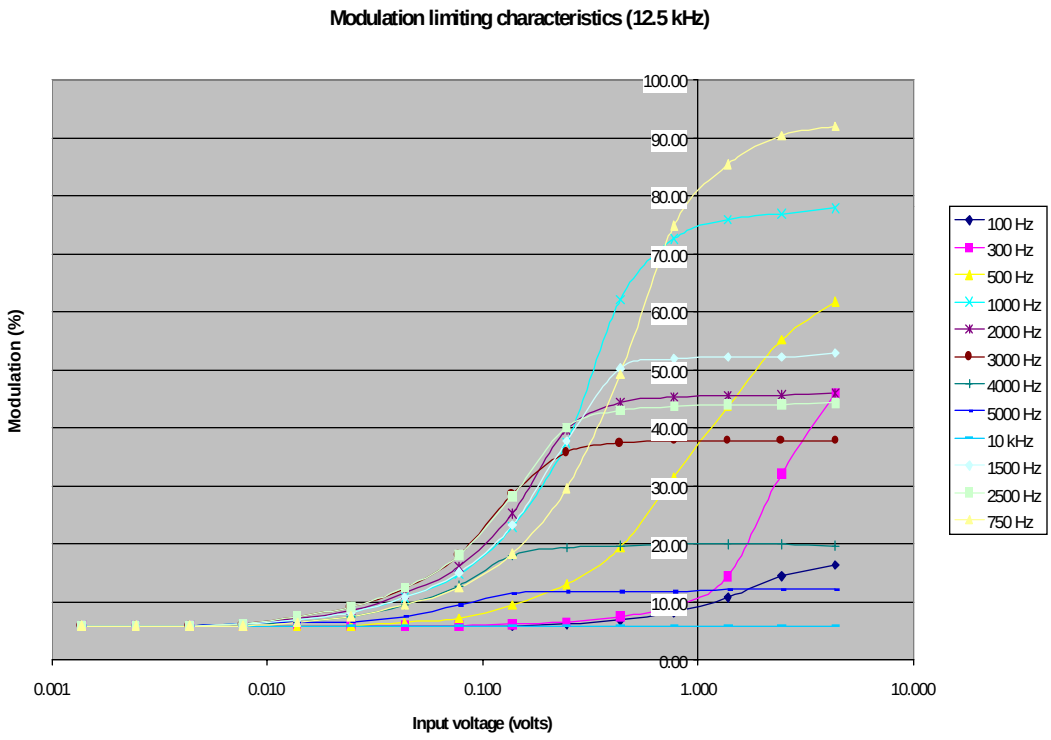
(b) A family of curves showing the percentage of modulation versus the modulation input voltage.

A family of curves showing the percentage of modulation versus the modulation. These measurements were carried out with modulating frequencies from 100 Hz to 10 kHz.

At each frequency the input voltage was slowly increased with the resulting frequency deviation of the transmitter being recorded.

This deviation was then converted to a modulation percentage where 2.5 kHz deviation is 100% for 12.5 kHz channeling.

CTCSS was not applied.



Result: Complies.

Measurement Uncertainty: ±1%.

Occupied Bandwidth

Section 90.209(b)(5) defines the authorised bandwidth as 4 kHz where 5 kHz channel spacing is used in the band 220 – 222 MHz.

Section 90.203(k) allows for a channel bandwidth greater than 5 kHz providing that operations are restricted to channels 1 through 160, 171 through 180 and 186 through 200 and where:

- (k)(1) a statement is made that the equipment meets the spectrum efficiency standard of at least one voice channel per 5 kHz of channel bandwidth or

- (k)(1) a statement is not made and the application for certification is filed after December 31st, 2001 or

- (k)(2) technical analysis demonstrates that the transmitter is more spectrally efficient that if the spectrum efficiency standard in (1) was applied.

Section 90.210(d) – Mask D has been applied in order to comply with the requirements of Section 90.203(k)(2).

The reference level for all emission mask measurements has been determined using a resolution bandwidth of 30 kHz and the transmitter not modulated.

Measurements were carried out with a 2500 Hz modulating frequency applied at a level 16 dB higher than the level required to achieve 50% modulation (1.25 kHz deviation). Additional measurements were at the frequency of maximum response, 750 Hz, at a level 16 dB higher than that required to achieve 50% modulation.

The following clauses are also covered by these tests:

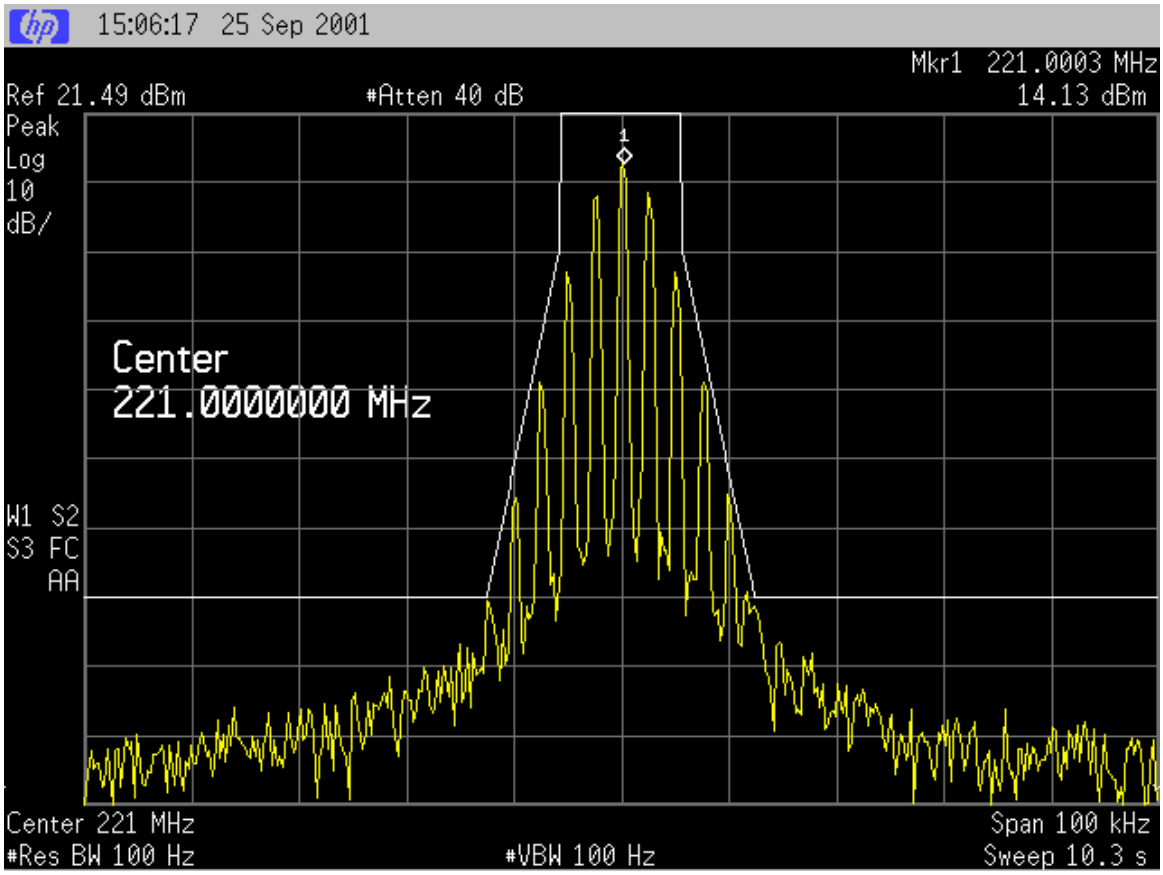
Part 90.207 – Emission types:
Emission type F3E is used.

Part 90.209 – Bandwidth limitations:
The necessary authorised bandwidth is taken to be the necessary bandwidth.

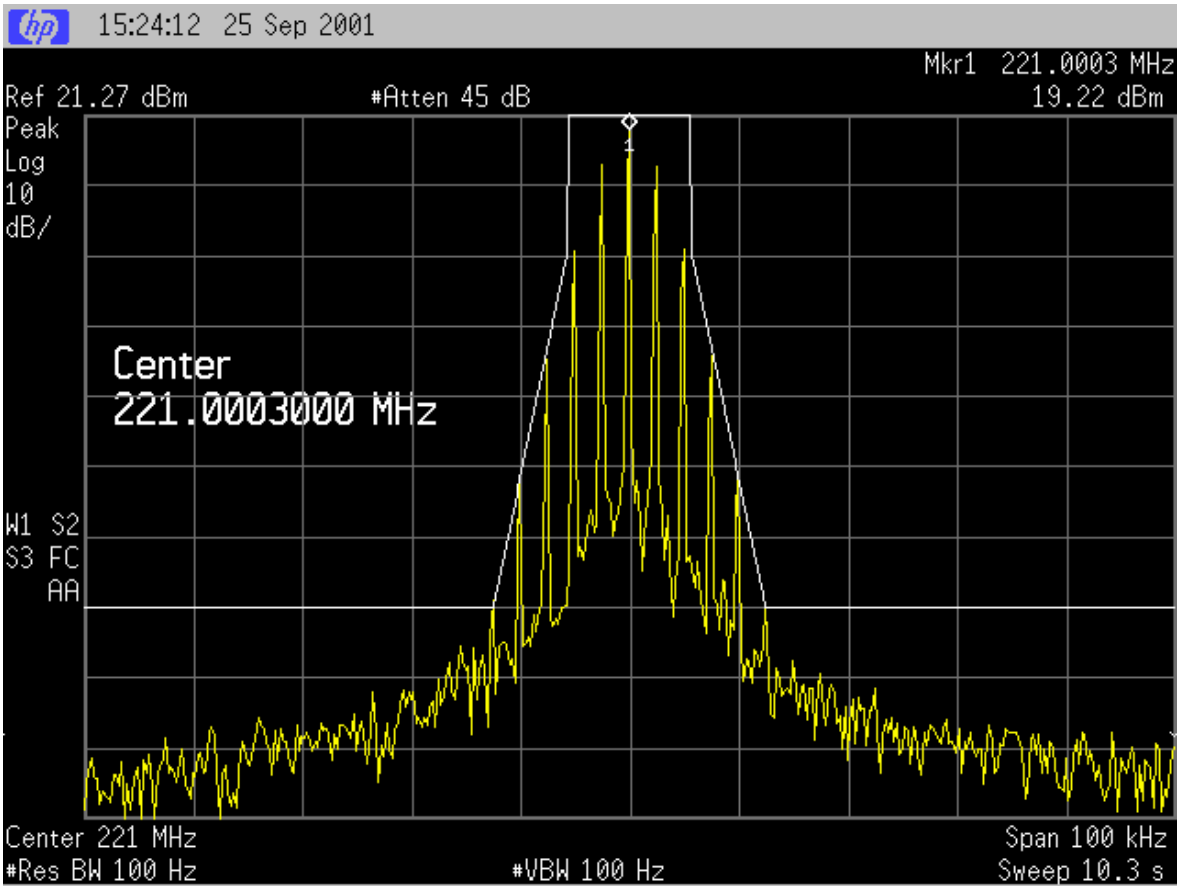
Using the formulas contained in Part 2.202:
$B_n = 2 \times D + 2 \times M$
Where D = maximum deviation: 2.5 kHz
Where M = maximum modulation frequency: 3 kHz
$B_n = 11$ kHz

This is confirmed in the emission designation, 11k0F3E as declared by the client.

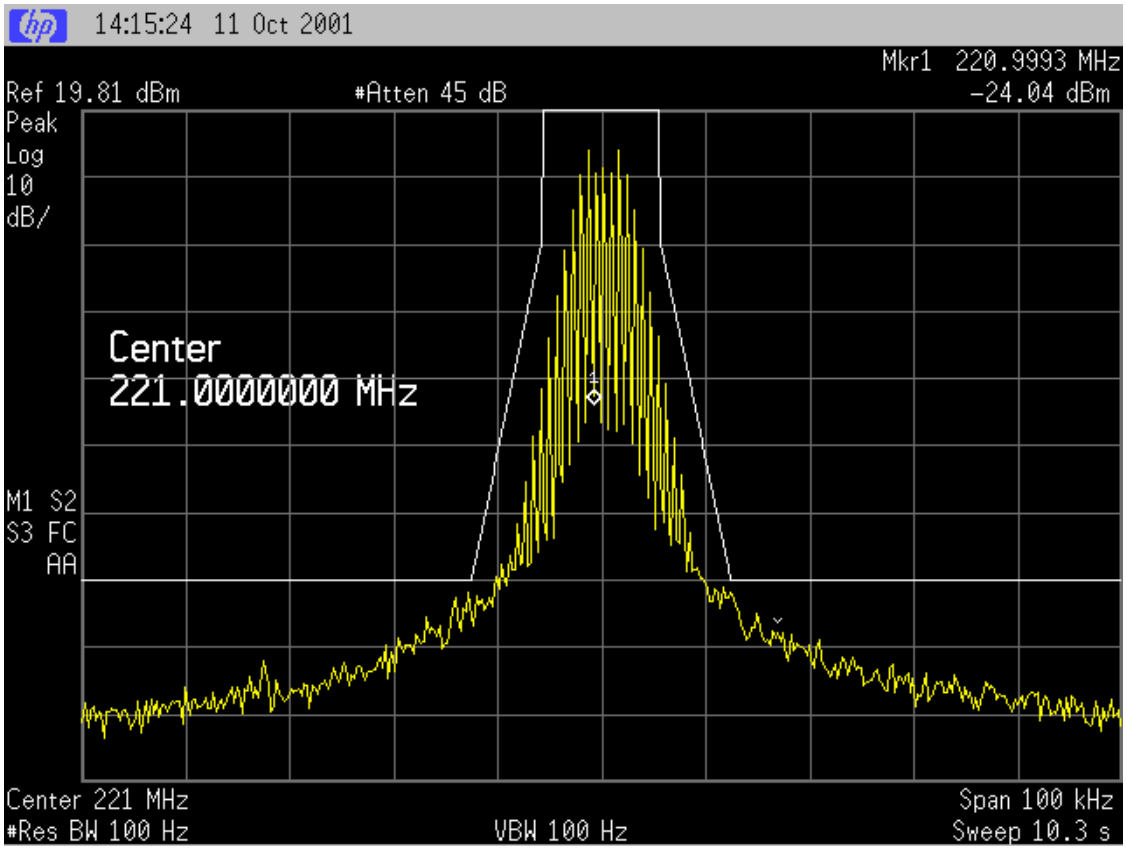
Plot 1: CTCSS applied with a 2500 Hz tone.



Plot 2: 2500 Hz tone applied with no CTCSS.



Plot 3: 750 Hz with no CTCSS applied.



Result: Complies

Spurious emissions at the transmitter antenna terminals

Frequency: 221.000 MHz

Measured Spurious Emission	
Spurious emission (MHz)	**Emission level (dBm)**
178.2	-36.8
210.5	-35.1
442.0	-33.0
663.0	-36.6
884.0	-31.6
1105.0	-40.8
1326.0	-46.2
1547.0	-47.0
1768.0	-46.0
1989.0	-45.0
2210.0	-46.4

Limit
Part 90.210(d) Mask D, (3) on any frequency removed from the centre of the authorised bandwidth by more than 12.5 kHz shall be attenuated by at least 50 + 10 log (P) or 70 dB which ever is the lesser.

Part 2.1051 states that emissions greater than 20 dB below the limit need not be reported.

Part 2.1057 states that the spectrum should be investigated up to the 10th harmonic if the transmitter operates below 10 GHz.

Rated power is 110 watts. 50 + 10 log (P) gives a limit of –20 dBm.

Measurements less than –40 dBm have been reported for information purposes only.

No measurements were made above the 10th harmonic.

Result: Complies.

Measurement Uncertainty: *±3.3 dB*

Field strength of transmitter spurious emissions at antenna terminals

Frequency: 221.000 MHz

Transmitter Harmonics:

Emission Frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Worst Case Margin (dB)	Worst Case Antenna Polarity
442.000	71.5	-25.9	-20.0	-5.9	Horizontal
663.000	61.4	-36.0	-20.0	-16.0	Horizontal
884.000	67.0	-30.4	-20.0	-10.4	Horizontal
1105.000	50.0	-47.4	-20.0	-27.4	Vertical
1326.000	72.3	-25.1	-20.0	-5.1	Horizontal
1547.000	61.8	-35.6	-20.0	-15.6	Vertical
1768.000	65.8	-31.6	-20.0	-11.6	Horizontal
1989.000	73.2	-24.4	-20.0	-4.4	Vertical
2210.000	64.1	-33.3	-20.0	-13.3	Vertical

Device was tested on an open area test site at a distance of 3 metres.

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Dakota Lane, Ardmore Aerodrome, Auckland. Details of this site have been filed with the Commission, Registration Number: 90838, which was last updated on February 11, 2000.

The transmitter tested operating on high power with a 50 Ω dummy load attached to the output while being powered using a 13.8 Vdc battery.

Testing was carried out using the substitution method. The power level of each emission was determined by replacing the transmitter with a dipole antenna that was connected to a signal generator.

The signal generator output level was increased until the same field strength level was observed at each emission frequency.

The level recorded is the signal generator output level in dBm less any losses / gains due to the coax cable and the antenna.

Limit

Part 90.210(d) Mask D, (3) on any frequency removed by more than 12.5 kHz from the centre of the authorised bandwidth, all emissions are to be attenuated by at least 50 + 10 log (P) or 70 dB whichever is less.

Part 2.1051 states that emissions greater than 20 dB below the limit need not be specified

Part 2.1057 states that the spectrum should be investigated up to the 10th harmonic if the transmitter operates below 10 GHz.

A rated power of 110 watts gives a limit of –20 dBm.

Result: Complies.

Measurement Uncertainty: *±4.1 dB*

Field strength of receiver spurious emissions

Receive frequency: 221.000 MHz

IF Frequencies: 45.0 MHz

Tests carried out in accordance with Part 15, Section 15.109.

Receiver Local Oscillator:

Frequency (MHz)	Level Vertical (dBuV/m)	Level Horizontal (dBuV/m)	Limit (dBuV/m)	Worst Case Margin (dB)	Worst Case Antenna Polarity
266.000	26.7	36.6	46.0	9.4	Horizontal
532.000	20.2	23.1	46.0	22.9	Horizontal
798.000	23.7	25.7	46.0	20.3	Horizontal
1064.000	-	-	54.0		Vert/Hort
1330.000	28.0	29.4	54.0	24.6	Horizontal
1596.000	-	-	54.0		Vert/Hort
1862.000	32.0	31.0	54.0	22.0	Vertical
2128.000	-	-	54.0		Vert/Hort
2394.000	-	-	54.0		Vert/Hort
2660.000	-	-	54.0		Vert/Hort

Other emissions observed (transmitter in standby):

Frequency (MHz)	Level Vertical (dBuV/m)	Level Horizontal (dBuV/m)	Limit (dBuV/m)	Worst Case Margin (dB)	Worst Case Antenna Polarity
52.000	18.0		40.0	22.0	Vertical
80.000	20.0		40.0	20.0	Vertical
82.000	19.0		40.0	21.0	Vertical
84.000	25.3		40.0	14.7	Vertical
86.000	21.0		40.0	19.0	Vertical
102.000	23.0		43.5	20.5	Vertical
106.000	26.0		43.5	17.5	Vertical
110.000	26.8		43.5	16.7	Vertical

Device was tested on an open area test site at a distance of 3 metres.

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Dakota Lane, Ardmore Aerodrome, Auckland. Details of this site have been filed with the Commission, Registration Number: 90838, which was last updated on February 11, 2000.

Testing carried out with a dipole antenna attached to the receiver module.

Limit
Part 15 section 15.109(a). The following limits have been applied:

30 – 88 MHz: 100 uV/m = 40 dBuV/m
88 – 216 MHz: 150 uV/m = 43.5 dBuV/m
216 – 960 MHz: 200 uV/m = 46.0 dBuV/m
above 960 MHz: 500 uV/m = 54.0 dBuV/m

Result: Complies

Measurement Uncertainty: *±4.1 dB*

Antenna power conduction limits for receivers.

Receive frequency: 221.0 MHz

IF Frequency: 45.0 MHz

Tests carried out in accordance with Part 15, Section 15.111.

As the transceiver has no dedicated antenna, spurious emission measurements were made at the antenna terminals using a spectrum analyser.

Measured Spurious Signals		
Spurious signal (MHz)	**Level at the receiver input (dBm)**	**Description**
266.0	-67.0	LO
532.0	-79.0	2LO
798.0	-81.0	3LO
1330.0	-82.0	5LO
2128.0	-79.0	8LO

All other emissions detected were less than –85 dBm.

Limit
The spurious emission power should not exceed 2 nW (-57 dBm).

Result: Complies

***Measurement Uncertainty*:** *±3.3 dB*

Transient frequency behaviour

Not applicable as this transmitter does not operate in the 150 – 174 MHz or the 412 – 512 MHz frequency bands.

Frequency Stability

Frequency stability measurements were made over the range - 30 °C to + 50°C in + 10°C increments.

At each temperature the transmitter was given a period of 30 minutes to stabilise.

Measurements were made with the supply varied between 115% and 85% of the nominal supply voltage (13.8 Vdc).

Nominal Frequency: 221.000 MHz

Frequency Error (Hz)			
Voltage Temp.	**11.7 Vdc**	**13.8 Vdc**	**15.9 Vdc**
+50°C	+53.0	+53.0	+53.0
+40°C	+66.0	+67.0	+67.0
+30°C	+72.0	+72.0	+72.0
+20°C	+54.0	+54.0	+54.0
+10°C	+68.0	+68.0	+67.0
0°C	+84.0	+83.0	+84.0
-10°C	+79.0	+78.0	+79.0
-20°C	-70.0	-71.0	-70.0
-30°C	+25.0	+24.0	+25.0

Limit
Part 90.213 states that the frequency stability requirement for base stations operating between 220 – 222 is 0.5 ppm.

This transmitter operates on 221.000 MHz.
0.1 ppm = 0.1 x 221.000 = 22 Hz.

The client has specified a stability requirement of 2.5 ppm = 552 Hz

Result: Complies with the stability requirement specified by the client.

Measurement Uncertainty: ±30 Hz

8. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial #	Asset
Aerial Controller	EMCO	1090	9112-1062	RFS 3710
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708
Attenuator	Hewlett Packard	8491A	24838	E1329
Attenuator	Wienschel	49-20-43	GC104	E1308
Audio Analyzer	Hewlett Packard	HP 8903B	2216A01713	E1146
Biconical Antenna	Schwarzbeck	BBA 9106		RFS 3612
Coax Cable	Sucoflex	104PA	2736/4PA	
DC Power Supply	Hewlett Packard	HP6032A	2743A-02859	E1069
Frequency Counter	Hewlett Packard	HP 5342A	1916A01835	E1224
Horn Antenna	Electrometrics	RGA-60	6234	E1494
Horn Antenna	EMCO	3115	9511-4629	E1526
Level generator	Anritsu	MG443B	M61689	E1143
Log Periodic Antenna	Schwarzbeck	UHALP 9107		RFS 3702
Measurement Receiver	Rohde & Schwarz	ESCS 30	839873/1	
Modulation Analyzer	Hewlett Packard	HP 8901B	2608A00782	E1090
Resistance Thermometer Meter	DSIR	RT200	35	E1409
RF Power Meter	Hewlett Packard	HP 436A	2512A22439	E1198
Rubidium Oscillator	Ball Efratom	FRS – C	4287	E1053
Signal Generator	Rohde and Schwarz	SMP-04	1035 5005.04	E1560
Spectrum Analyser	Hewlett Packard	E7405A	US 39150142	RFS 3776
Spectrum Analyzer	Hewlett Packard	E7405A	US39150142	3776
Thermal chamber	Contherm	M180F	86025	E1129
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709

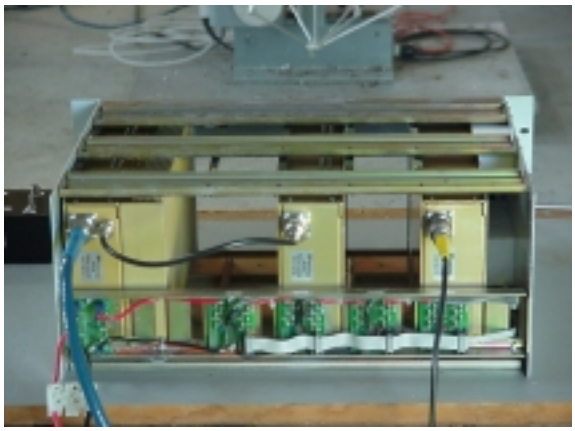
9. ACCREDITATIONS

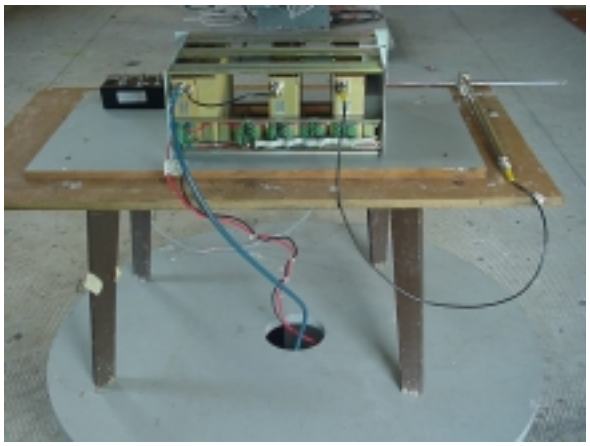
Testing was carried out in accordance with EMC Technologies NZ Ltd registration with the Federal Communications Commission as a listed facility, Registration Number: 90838, which was updated on February 11th, 2000.

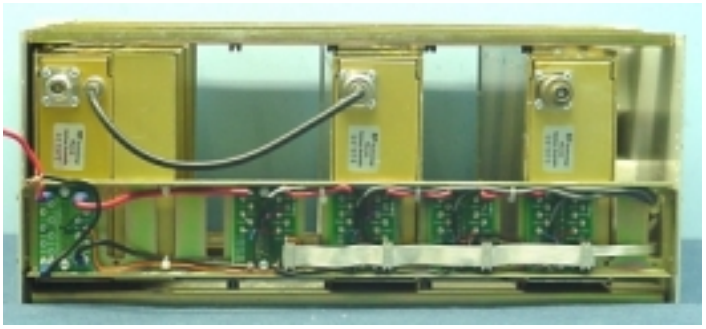
All measurement equipment has been calibrated in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to the New Zealand Code of Laboratory Management Practice incorporating ISO Guide 25: 1990 and ISO 9002: 1994.

10. PHOTOGRAPH (S)

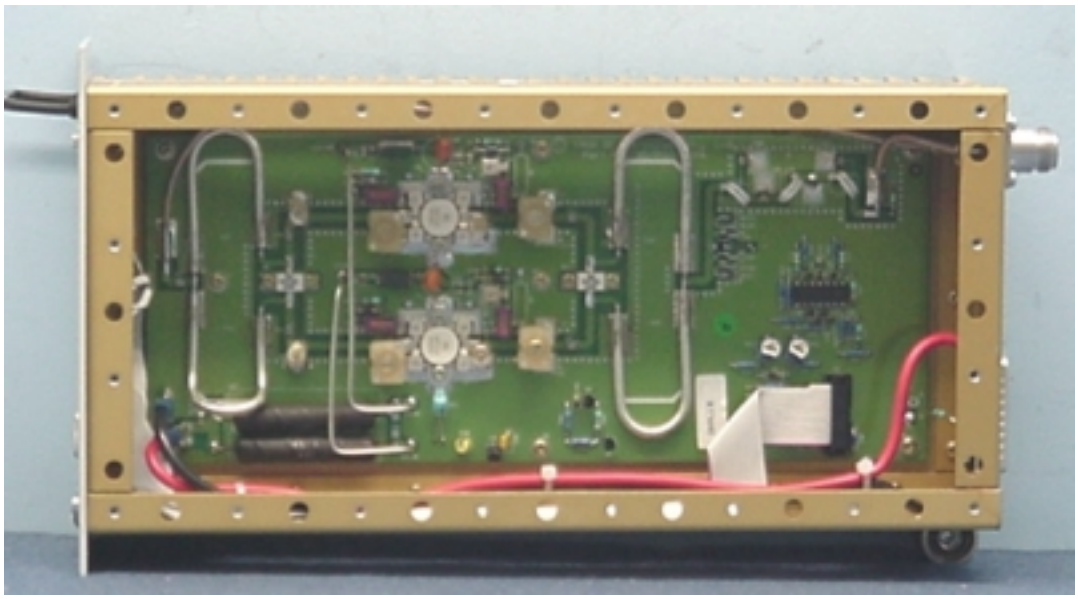
RADIATED EMISSION TEST SET UP FOR THE RECEIVER, EXCITER AND POWER AMPLIFIER.



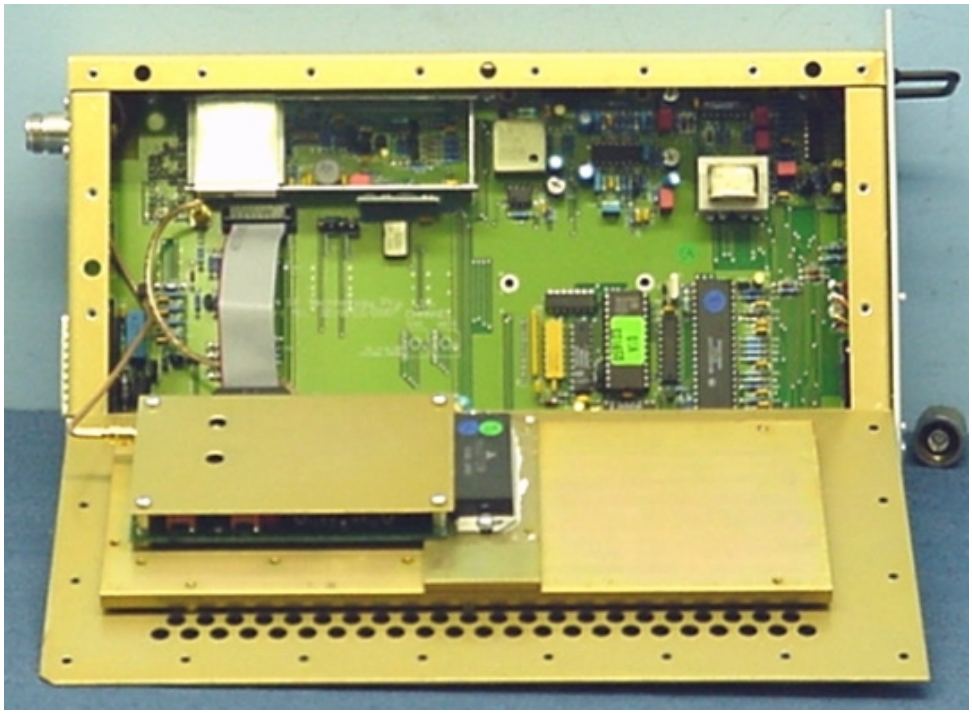


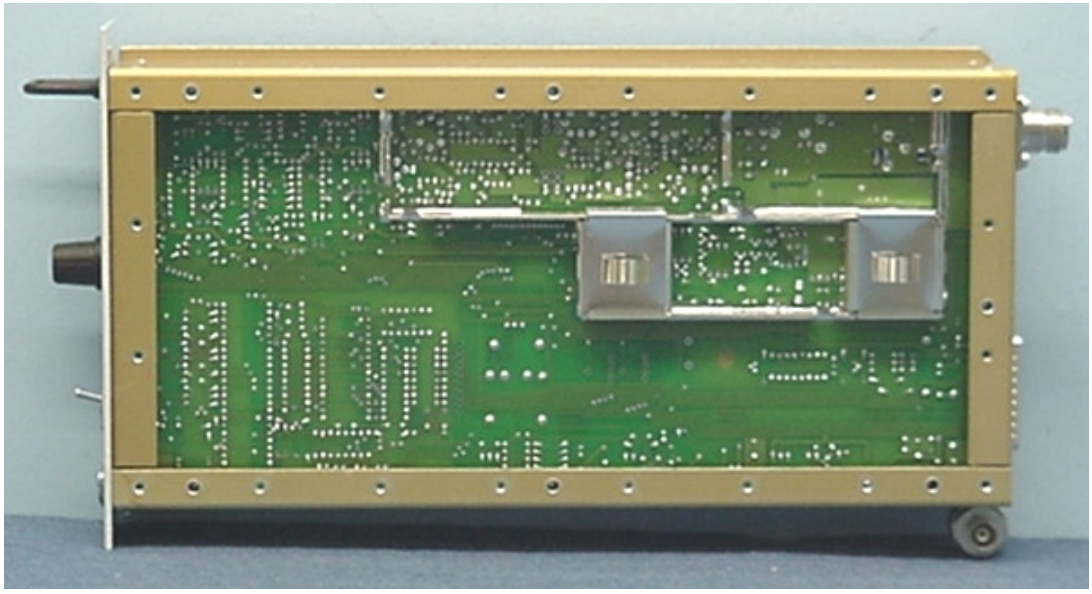


Power amplifier



Exciter





Receiver